

REMARKS

Reconsideration of this application, as amended, is respectfully requested.

Claims 23-32 are pending. Claims 23 and 25-32 were rejected. Claim 24 was objected to.

Claims 23 and 24 have been amended. No claims have been cancelled. Claims 33 and 34 have been added. Support for the amendments is found in the specification, the drawings, and in the claims as originally filed. Applicant submits that the amendments do not add new matter.

Rejections Under 35 U.S.C. § 103

Claims 23, 25, 26, 27, 28, 29, 30, 31, 32 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Akram of U.S. Patent No. 5,903,058 ("Akram"), in combination with David et al. of U.S. Patent No. 6,130,170 ("David").

Applicants have amended claim 23 to indicate that at least one of the metal second layer and the metal third layer is compressively stressed.

Akram discloses under bump metallurgy pads. More specifically, Akram discloses

FIG. 2e shows metal layers 68, 70, and 72 applied over the passivation film face surface 60 as well as the via 62 to form a composite or laminate UBM 74 by CVD, PECVD, or PVD such as sputtering or evaporation. The metal layers usually comprise chrome for the first layer 68, chrome-copper alloy for the second layer 70, and copper for the third layer 72. Each of these layers may be about 1000 .ANG. thick, although this is not a requirement of the invention. Additionally, a fourth metal layer (not shown) of gold may be deposited or flashed atop the copper third layer 72 to prevent oxidation of the copper. As noted previously, a multitude of other acceptable metals may be used as metal layers. For example, a Ti/TiW/Cu stack or laminate provides another suitable combination. The invention is not limited to any particular UBM metallurgy or to multi-layer UBMs.

(Akram, col. 6, lines 4-18) (emphasis added)

Thus, Akram merely discloses Ti/TiW/Cu stack, wherein each of the layers of the stack may be about 1000A thick, and fails to disclose that at least one of the metal second layer and the metal third layer of the stack is compressively stressed, as recited in amended claim 23.

David discloses a seed layer for Ball Limiting Metallurgy. More specifically, David discloses

The seed layer is typically composed of several metal layers, which serve the additional purpose of forming the BLM metallurgy.

Examples of first layers used in this method include chromium (Cr), titanium-tungsten alloys (TiW), or any other metals which adhere well to the substrate at hand. This metal layer, which will function as part of the seed layer for electrodepositing solder balls, might be a ten-thousandth of a millimeter thick. On top of the first layer may be deposited a second layer, which may be an alloy of chromium-copper (CrCu) or nickel-vanadium (NiV). Finally, a third layer, usually of pure copper is deposited over the other layers. The thickness of the layers may vary, and is typically chosen to optimize the stress-thickness product, diffusion properties, and mechanical integrity.

(David, col. 3, lines 2-16) (emphasis added)

Thus, David merely discloses the seed layer that has three metal layers and fails to disclose that at least one of the metal second layer and the metal third layer of the seed layer is compressively stressed, as recited in amended claim 23.

Hence, neither Akram, nor David discloses, teaches, or suggests the limitations of amended claim 23 of at least one of the metal second layer and the metal third layer of the seed layer is compressively stressed.

Furthermore, even if Akram and David were combined, such a combination would lack such the limitations of amended claim 23.

Therefore, Applicants respectfully submit that amended claim 23 is not obvious under 35 U.S.C. § 103(a) over Akram in view of David.

Given that claims 25-32 depend from amended claim 23 and add additional limitations, Applicants respectfully submit that claims 25-32 are likewise not obvious under § 103 (a) over Akram in view of David.

New claim 33 reads as follows.

A system comprising:
a substrate comprising an electrical device;
a metallization pad disposed over the substrate;
a ball-limiting metallurgy disposed over the metallization pad, the
ball-limiting metallurgy comprising:
a metal adhesion first layer disposed above and on the metallization
pad;
a metal second layer of copper disposed above and on the metal
adhesion first layer;
a metal third layer disposed above and on the metal second layer,
wherein the metal third layer comprises a copper stud;
an electrically conductive bump disposed above and on the metal
third layer; and
a flip-chip disposed over the ball-limiting metallurgy.

(New claim 33) (emphasis added)

Applicants added new claim 33 to particularly point out that a metal second layer of copper is disposed above and on the metal adhesion first layer and that a metal third layer disposed above and on the metal second layer of copper, comprises a copper stud.

Akram, as set forth above, merely discloses a copper layer on a chrome-copper or TiW alloy layer on an adhesive layer (col. 6, lines 4-18) in contrast to a copper stud deposited on a copper layer on an adhesion layer, as recited in new claim 33.

David, as set forth above, merely discloses a copper layer deposited on CrCu or NiV layer on an adhesion layer, in contrast to a copper stud deposited on a copper layer on an adhesion layer, as recited in new claim 33.

Thus neither Akram, nor David, discloses, teaches, or suggests the limitations of new claim 33 of a metal second layer of copper disposed above and on the metal adhesion first layer and a metal third layer comprising a copper stud, disposed above and on the metal second layer of copper.

Furthermore, even if Akram and David were combined, such a combination would lack such the limitations of amended claim 23.

Therefore, Applicants respectfully submit that amended claim 23 is not obvious under 35 U.S.C. § 103(a) over Akram in view of David.

Given that claim 34 depends from amended claim 33 and add additional limitations, Applicants respectfully submit that claim 34 is likewise not obvious under § 103 (a) over Akram in view of David.

Allowable Subject Matter

Claim 24 is objected to as being dependent upon a rejected base claim, but is indicated to be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

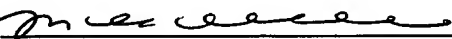
Claim 24 depended directly from claim 23. Applicants here have amended claim 24 to include all the limitations of claim 23. Thus claim 24 is now allowable.

It is respectfully submitted that in view of the amendments and arguments set forth herein, the applicable rejections and objections have been overcome. If there are any additional charges, please charge Deposit Account No. 02-2666 for any fee deficiency that may be due.

Respectfully submitted,

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